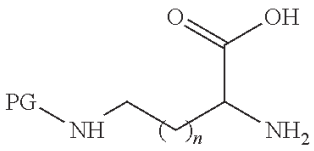
pyrrolidone, diglyme, ethyl glyme, proglyme, ethyldiglyme, m-cresol, p-cresol, o-cresol, xylenes, ethylene glycol and phenol among others.

[0014a] Disclosed embodiments describe methods for the synthesis of 3,6-bis-[N-protected aminoalkyl]-2,5-diketopiperazine comprising:

Formula I



heating a mixture of an amino acid of general formula I in the presence of a catalyst in an organic solvent;

wherein PG is selected from the group consisting of trifluoroacetyl, CBz, and acetyl, and n is 0 to 3;

wherein the catalyst is selected from the group consisting of: sulfuric acid, and phosphorous pentoxide, and is present in a concentration of 20 to 50% that of the amino acid; and

wherein the solvent is selected from the group consisting of: dimethylacetamide, N-methyl-2-pyrrolidone, diglyme, ethyl glyme, proglyme, and ethyldiglyme.

[0015] The disclosed embodiments also describe methods wherein n is between from 1 to 7, wherein n is equal to 3, wherein n is equal to 2, wherein PG is an amide forming protecting group, wherein the protecting group is trifluoroacetyl, wherein PG is a carbamate forming protecting group, wherein the protecting group is Cbz, wherein the solvent is substantially water miscible, wherein the solvent is N-methyl-2-pyrrolidone, wherein the amino acid is ε-trifluoroacetyl-L-lysine, wherein the amino acid is ε-Cbz-L-lysine, wherein the amino acid is ɣ-trifluoroacetyl-ornithine, wherein the amino acid is ɣ-

Cbz-ornithine, wherein the catalyst is phosphorous pentoxide, wherein the concentration of phosphorous pentoxide is from 10% to about 50% that of the amino acid, and embodiments further comprising the step of quenching the mixture with water.

[0016] Disclosed embodiments describe methods for the synthesis of 3,6-bis-[N-protected aminobutyl]-2,5-diketopiperazine comprising: heating a mixture of a N-protected lysine in the presence of a catalyst in an organic solvent, to a temperature of between 110º and 175ºC for between 0.25 and 5 hours; wherein the catalyst is selected from the group comprising sulfuric acid, phosphoric acid and phosphorous pentoxide, the concentration of catalyst from about 5% to about 50% that of the lysine; and the solvent is selected from the group comprising: dimethylacetamide, N-methyl-2-pyrrolidone, diglyme, ethyl glyme, proglyme, ethyldiglyme, m-cresol, p-cresol, o-cresol, xylenes, ethylene glycol and phenol.